

[1] J. Hasper et al., Phys. Rev. C, accepted, [arXiv:0711.2603]

Gruppenbericht

HK 24.2 Di 11:30 2B

Low-energy cross sections of the BBN reaction $d(\alpha, \gamma)^6\text{Li}$ by Coulomb dissociation of ^6Li — ●MICHAEL HEIL¹, KLAUS SUEMMERER¹, FAIROUZ HAMMACHE², DANIEL GALAVIZ³, STEFAN TYPPEL⁴, and S246 COLLABORATION¹ — ¹GSI Darmstadt, Germany — ²IPN Orsay, France — ³TU Darmstadt, Germany — ⁴GANIL Caen, France

The primordial abundances of D, (³He), ⁴He, and ⁷Li can be used to infer the baryon density of the Universe based on the framework of Big-Bang Nucleosynthesis (BBN). By precision measurements of the cosmic microwave background (CMB) an independent method became available recently. This lead to a renewed interest for BBN. Together with the recent observation of ⁶Li in old stars and the problems to reconcile calculated primordial ⁷Li abundances with those predicted on the basis of CMB results, the production of both, ⁶Li and ⁷Li in BBN has been reinvestigated. One important ingredient is the low-energy S-factor of the d-alpha radiative-capture reaction. Up to now, the only available experimental result by Kiener et al. (1991) introduced an uncertainty of about a factor of 20 in the ⁶Li yield. We have therefore reinvestigated the d-alpha reaction with the help of Coulomb dissociation (CD) of ⁶Li at 150 MeV/nucleon at GSI. CD is the only practical way to study the low-energy S-factor (which involves l=2 multipolarity) due to the large number of E2 photons contained in the equivalent-photon flux. Preliminary results indicate a drop of the S-factor as predicted by theory, contrary to the constant low-energy S-factor resulting from the previous study.

HK 24.3 Di 12:00 2B

Color superconducting quark matter in compact stars — DAVID BLASCHKE¹, ●THOMAS KLAEHN², FREDRIK SANDIN³, CHRISTIAN FUCHS⁴, AMAND FAESSLER⁴, GERD ROEPKE⁵, JOACHIM TRUEMPER⁶, and STEFAN TYPPEL⁷ — ¹Uni Wroclaw, Polen — ²ANL, USA — ³Lulea UT, Sweden — ⁴Uni Tuebingen, Germany — ⁵Uni Rostock, Germany — ⁶MPE Garching, Germany — ⁷GANIL, France

Recent indications for high neutron star masses ($M \sim 2 M_{\odot}$) and large radii ($R > 12$ km) could rule out soft equations of state and have provoked a debate whether the occurrence of quark matter in compact stars can be excluded as well. We show that modern quantum field theoretical approaches to quark matter including color superconductivity and a vector meanfield allow a microscopic description of hybrid stars which fulfill the new, strong constraints. For these objects color superconductivity turns out to be essential for a successful description of the cooling phenomenology in accordance with recently developed tests. We discuss QCD phase diagrams for various conditions thus providing a basis for a synopsis for quark matter searches in astrophysics and in future generations of nucleus-nucleus collision experiments such as low-energy RHIC and CBM @ FAIR.

HK 24.4 Di 12:15 2B

Influence of Mass Uncertainties of Exotic Nuclei on the rp - and νp -Process — ●TIMO FLECKENSTEIN¹, HANS GEISSEL¹, WOLFGANG PLASS^{1,2}, CHRISTOPH SCHEIDENBERGER^{1,2}, HENDRIK SCHATZ³, and GABRIEL MARTINEZ-PINEDO² — ¹Justus-Liebig-Universität Gießen — ²GSI Darmstadt — ³Michigan State University

The impact of mass uncertainties of proton-rich nuclei with $A=80-105$ on astrophysical observables, e.g. x-ray burst light-curves, production path and final chemical abundance produced in nucleosynthesis (rp - and νp -) processes has been investigated. A database of mass measurements in the mass region $A=80-135$ since the last atomic-mass evaluation AME 2003 has been created. In addition, extrapolations have been done to hitherto experimentally unknown masses close to the proton dripline. In order to investigate the dependence of nucleosynthesis processes on mass uncertainties, a network-code for nucleosynthesis processes in a type II x-ray burst and for the nucleosynthesis processes in neutrino-driven proton rich winds of a supernova explosion have been applied. New waiting point nuclei have been found in the rp -process, and important key nuclei have been discovered for the νp -process.

HK 24.5 Di 12:30 2B

Einfluss von Spaltungsprozessen auf die Isotopenverteilung im r-Prozess — ●ILKA PETERMANN^{1,2}, ALEKSANDRA KELIC², KARLHEINZ LANGANKE^{2,1}, GABRIEL MARTÍNEZ-PINEDO², IGOR PANOV³, THOMAS RAUSCHER³, KARL-HEINZ SCHMIDT², FRIEDRICH-KARL THIELEMANN³ and NIKOLAJ ZINNER⁴ — ¹IKP, TU Darmstadt,

Germany — ²GSI, Darmstadt, Germany — ³Department für Physik und Astronomie, Universität Basel, Switzerland — ⁴Institute for Physics and Astronomy, University of Århus, Denmark

Die Entstehung der Elemente jenseits von Eisen ist etwa zur Hälfte auf den r-Prozess zurückzuführen, einer Abfolge schneller Neutroneneinfangreaktionen und Betazerfälle in explosiven Szenarien mit hohen Neutronendichten. Reaktionsnetzwerke zur Nukleosynthese, die die zeitliche Entwicklung von Isotopenhäufigkeiten beschreiben, setzen die Kenntnis einer großen Anzahl von teilweise ausschließlich theoretisch bestimmten Wirkungsquerschnitten und Reaktionsraten voraus, die die Produktion und Vernichtung der einzelnen Isotope festlegen. Wegen stark unterschiedlicher Zeitskalen der Reaktionsraten liegt mit den Netzwerkgleichungen ein System steifer Differentialgleichungen vor, in dessen Lösungsansätzen die schwache Besetztheit der zugrundeliegenden Matrix ausgenutzt wird. Der Netzwerkcode wird hier um neutroneninduzierte und betaverzögerte Spaltung ergänzt, wobei für einen weiten Isotopenbereich auch auf verbesserte Reaktionsraten zurückgegriffen werden kann. Der Einfluss von Spaltungsprozessen auf die Isotopenverteilung im r-Prozess kann somit diskutiert und mit vorhergehenden Ergebnissen verglichen werden.

HK 24.6 Di 12:45 2B

shell-model half-lives for N=82 nuclei and their implications for the r-process — ●JOSE CUENCA-GARCIA¹, GABRIEL MARTINEZ-PINEDO¹, KARL-HEINZ LANGANKE^{1,2}, IVAN BORZOV¹, and FREDERIC NOWACKI³ — ¹Gesellschaft für Schwerionenforschung Plankstr. 1 64259 Darmstadt — ²Institut für Kernphysik TU-Darmstadt Schlossgartenstr. 9 64289 — ³Institut de Recherches Subatomiques, Université Louis Pasteur 67097 Strasbourg, France

We have performed shell-model calculations of the half-lives and neutron-branching probabilities of the r-process waiting point nuclei at the magic neutron number $N = 82$. These new calculations use a larger model space than previous shell model studies and an improved residual interaction which is adjusted to recent spectroscopic data around $A = 130$. Our shell-model results give a good account of all experimentally known half-lives and Q-values for the $N = 82$ r-process waiting point nuclei. Our half-life predictions for the $N = 82$ nuclei with $Z = 42-46$ agree well with recent estimates based in the energy-density functional method.

HK 24.7 Di 13:00 2B

The stellar neutron capture cross section of ^{60}Fe — ●RENE REIFARTH¹, MICHAEL HEIL¹, DOROTHEA SCHUMANN², IRIS DILLMANN³, CESAR DOMINGO-PARDO³, FRANZ KÄPPELER³, JUSTYNA MAGANIEC³, FRITZ VOSS³, STEFAN WALTER³, ETHAN ÜBERSEDER⁴, JOACHIM GÖRRES⁴, and MICHAEL WIESCHER⁴ — ¹GSI, Planckstr. 1, 64291 Darmstadt, Germany — ²PSI, 5313 Villigen, Switzerland — ³FZK, P.O. Box 3640, 76021 Karlsruhe, Germany — ⁴University of Notre Dame, Physics Department, Notre Dame, IN 46556, USA

^{60}Fe is one of the most interesting radioisotopes found on earth. With an half-life of 1.5 Myr it is sensitive to the younger history of the universe (seen as ^{60}Co decays) and the earth (seen as ^{60}Fe in deep sea manganese crusts), but contains basically no pre-solar information. In order to use the observational information in a quantitative manner, production and destruction mechanisms of ^{60}Fe have to be understood.

Therefore we measured the neutron capture cross section of ^{60}Fe in the astrophysically interesting energy region applying the activation technique at the Forschungszentrum Karlsruhe (FZK). The sample material of $1.1 \cdot 10^{16}$ atoms has been retrieved from a copper beam stop, which has been irradiated with protons at the Paul Scherrer Institute (PSI).

HK 24.8 Di 13:15 2B

Stellar (n, γ) cross section of proton-rich nuclei — ●JUSTYNA MAGANIEC^{1,2}, IRIS DILLMANN², CESAR DOMINGO PARDO², PETER GRABMAYR³, and FRANZ KÄPPELER² — ¹Institute of Physics, University of Lodz, 90-236 Lodz, Poland — ²Institut für Kernphysik, Forschungszentrum Karlsruhe, 76344 Eggenstein-Leopoldshafen, Germany — ³Physikalisches Institut der Universität Tübingen, D-72076 Tübingen, Germany

The neutron capture cross sections of proton-rich nuclei are needed for nucleosynthesis studies of the heavy elements in the p process. In this process, (n, γ) reactions compete with (γ, n) reactions and play a secondary role in the freeze-out phase. So far, the neutron capture cross sections for several of these isotopes were not yet experimentally determined.